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- 1 **Title:**
- 2 Cryotherapy in Sport: A Warm Reception for the Translation of Evidence into Applied
- 3 **Practice.**
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28 Short Communication:

29 Precise mechanisms behind cryotherapy applications for acute sport injury management are complex and remain to be fully elucidated due to multiple factors affecting 30 'optimal' application in sporting contexts. Consequently, debate in the literature surrounding 31 the efficacy of cryotherapy for sport injury management is evident and ongoing. Despite the 32 common application of cryotherapy and understanding of the mechanisms underpinning 33 cooling available, confusion still exists in terms of the translation of underpinning mechanisms 34 35 into optimal protocols advantageous to the athlete in an applied setting. Recently Long and Jutte (2020) raised concerns regarding unverified claims on the negative comments against the 36 37 use of cryotherapy in sport and health settings for acute soft-tissue injury. In the field of sports medicine and performance, practitioners should be cautious of unverified claims without 38 39 consideration of best practice; more importantly however, this raises the need for sustained, real-world implementation of translational knowledge into applied settings which is lacking 40 41 despite many robust and excellent studies available on the topic of cryotherapy application in sport. The successful act of bridging the gap between academia/science (research) and practice 42 is recently acknowledged by Owoeye et al, (2020) highlighting the importance of 'theory-43 44 *driven translational research*' to guide applied and current practices. Although high-quality research in the generalised topic of cryotherapy aim to reduce subsequent scepticism amongst 45 practitioners influenced by weak, unverified or outdated approaches, methodological designs 46 in 'discovery research' that reflect current applications, encompass multi-measures and 47 acknowledge several mechanisms of cryotherapy should be implemented which will 48 consequently support translation of research findings successfully, whether for or against its 49 use in acute injury management. 50

This leads on to highlight the current perspectives on contemporary cryotherapy 51 52 applications are evolving and include recently published acronyms such as 'PEACE & LOVE' (Dubois and Esculier, 2020) (Table 1), whereby the suggestion of removing cryotherapy from 53 acute injury management is presented. Alternatively, Long and Jutte (2020) recommend 54 cryotherapy as part of treatment protocol based on grounded physiological evidence yet refer 55 56 only to the historical acronym of 'RICES' for practitioners to follow in terms of justification for cryotherapy application. As the authors suggest, there is a clear need to clarify 21st century 57 58 attacks on cryotherapy due to confusion amongst practitioners and therefore it seems pertinent to acknowledge the progressions of 'RICES' to 'PRICE', 'POLICE' and most recently 59 'PEACE & LOVE' acronyms (see full summary in Table 1) to provide a transparent 60

presentation of contemporary approaches for / against its use in acute injury management. The 61 latter acronym of PEACE & LOVE (table 1) is suggested as a continuum of acute sport injury 62 (PEACE) and rehabilitation (LOVE) management (Dubois and Esculier, 2020), yet not 63 mentioned in the work by Long and Jutte (2020). Interestingly, Long and Jutte (2020) cite a 64 robust evidence base supporting the use of cryotherapy to control the inflammatory process 65 that occurs as a result of soft tissue injury. In contrast, Dubious and Esculier, (2020) suggest 66 that there is no strong evidence base to provision this approach. Importantly, these studies 67 draw opposing conclusions in relation to the efficacy of cryotherapy on inflammatory response, 68 69 yet consequently the evidence cited in both pieces of work questions the conclusions drawn. The elimination of cryotherapy ('ice') completely from acute sports injury management 70 requires further investigation and contradicts earlier literature supporting the justification of 71 ice within acronyms such as POLICE based on cold-induced analgesia (Bleakley et al, 2012). 72 It is known that cooling has a beneficial effect on the perception of pain through the slowing 73 of neural conductance velocity, with sensory neurons effected ahead of motor neurons 74 75 contraindications on functional movement are secondary to the reduction of perceived pain (White & Wells, 2013). Hence it is important to note the surrounding benefits of such modality 76 in an applied practice situation for pain management alone following sport injury. Yet, the 77 78 many acronyms presented in the literature only aid to the confusion in practice and this editorial hope to stimulate the development of new research that rigorously examines such 79 80 recommendations to provide clarity on understanding and accuracy of credible evidencedbased literature which influences applied practice. 81

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[Table 1 Near Here]

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85 Table 1. Progression and explanation of acronym development which incorporate

86 cryotherapy (in local form 'ice') for acute injury management and accompanying reference

- 87 for summary.
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ACRONYM	EXPLANATION	SUPPORTING REFERENCE
ICE	Ice, Compression and Elevation	Bleakley et al, (2012).
RICE	Rest, Ice, Compression, Elevation	Bleakley et al, (2012).

RICES	Rest, Ice, Compression, Elevation and	Long and Jutte,
	Stabilisation	(2020).
PRICE	Protection, Rest, Ice, Compression and Elevation.	Bleakley et al, (2011).
POLICE	Protection, Optimal Loading, Ice, Compression and Elevation	Bleakley et al, (2012).
PEACE & LOVE	Protection, Elevation, Avoid Anti- Inflammatories, Compression, Education & Load, Optimism, Vascularisation and Exercise.	Dubois and Esculier, (2020).

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90 Discrepancies in the role of cooling for sport injury make it difficult for practitioners to 91 apply optimal applications in sport. Some approaches in studies may inhibit the translational 92 delivery of findings into practice perhaps due to methods not representative of an applied performance nature. Furthermore, several variables, such as dose-response or periodisation of 93 94 cooling for example which influence optimal sports injury mechanisms still require clarity. 95 Peer-reviewed research reflecting contemporary cryotherapeutic approaches that challenge outdated concepts are important to develop modern-day practices and are required to bridge 96 97 the gap between academia (research) and applied practice. The consideration of practices only becoming 'evidenced based' may relate to methodologies in translational research which truly 98 reflect current applied approaches and, as suggested by Owoeye et al, (2020), are executed 99 100 through context-specific dissemination and implementation study design. Mechanisms behind cryotherapy include physiological, biomechanical, biochemical and psychological wellbeing 101 responses and consequently play a part in optimal applications/protocol designs of such 102 therapeutic modalities and should be investigated in synthesis. Conceptual approaches in 103 cryotherapy research design considering ecological context and best translation of findings to 104 105 key audiences is supported.

Optimal applications of cryotherapeutic modalities in sport are important to ensure 106 107 maximum physiological benefit for injury and competitive advantage for performance. Holistic, 108 multifactorial approaches to sports injury management and recovery are welcomed, however 109 if sports practitioners are encouraged to base their justification for therapeutic modality use on the best available evidence, then further research to support or refute contemporary approaches 110 111 are warranted. Long and Jutte (2020) provide a relevant argument in support of cryotherapy, yet alternatively Dubois and Esculier, (2020) provide constructive challenges to historical 112 approaches for the optimal 'timing' of cryotherapy for acute sport injury management. 113

Contention however, between whether the use of cryotherapy 'does or doesn't work' is a 114 simplistic and disputed approach as to its many positive beneficial mechanisms which are 115 advantageous to the athlete. For the development of optimal cryotherapeutic protocols for sport 116 injury, rehabilitation or recovery, methodological design of future studies incorporating 117 biomechanical, biochemical, physiological and psychological mechanisms which reflect 118 current multi-measures of performance and the examination of contemporary modalities with 119 analysis which reflects individual response to interventions may provide more effective transfer 120 of contemporary knowledge into applied practice due to the resemblance of current cryotherapy 121 122 use in sport.

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142 Table Captions

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Table 1. Progression and explanation of acronym development which incorporate

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146 for summary.